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ABSTRACT

Discussed is a research project designed to measure the relative effects of audiotape versus videotape feedback in a microteaching situation. Teachers were randomly assigned to one of three groups; audiotape feedback, videotape feedback, control. The teachers in the two feedback groups participated in an instructional sequence on microteaching procedures which involved about 13 hours of instruction in a four-week period. Teachers were asked to conduct tutoring sessions before and after the training sequence. Videotapes of these sessions were rated for the teacher's use of diagnostic questions, demonstration techniques, evaluation examples, practice phases, and verbal praise. The results indicate that videotape and audiotape feedback are generally equally effective in producing gains in these tutoring skills. (CT)

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ABSTRACT

Improving Teachers' Mathematics Tutoring Skills Through Microteaching: A Comparison of Videotape and Audiotape Feedback[1]

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and Westinghouse Learning Corporation

Thirty-five teachers using Project Plan (an individualized instruction curriculum) were recruited to take Minicourse 5, "Individualizing Instruction in Mathematics." Teachers were randomly assigned to receive either videotape or audiotape feedback in microteaching. Another 15 teachers served as controls. To evaluate the treatments, all teachers conducted two tutoring sessions before and after the course. Findings indicate that videotape and audiotape feedback are generally equally effective in producing gains in certain tutoring skills: asking diagnostic questions; using demonstration techniques, e.g. manipulatives, number line, expanded notation; assigning problems for practice. The control group showed no pre-post gains in any of the tutoring skills.

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1. Paper presented at the Annual Meeting of the American Educational Research Association, New York, February 1971.
2. Dr. Dell is affiliated with Westinghouse Learning Corporation.

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IMPROVING TEACHERS' MATHEMATICS TUTORING SKILLS THROUGH MICROTEACHING: A COMPARISON OF VIDEOTAPE AND AUDIOTAPE FEEDBACK

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Objective of Study

Microteaching is becoming widely accepted as a method of teacher training. The essence of microteaching is its focus on specific classroom skills, rather than on vague generalizations about good teaching. The conditions under which these skills are to be learned, however, vary. Allen and Clark (1967, p. 75) state: "A precise definition of the micro-teaching context can vary according to the purposes and resources of the user. Some of the variables which can be adjusted include lesson length, number of pupils, types of pupils, number of reteaches, the amount and kind of supervision and the use of videotape." A substantial number of research studies have been carried out recently to determine which of these variables contribute to microteaching's effectiveness.[2] The purpose of the study reported here is to compare the relative effectiveness of two types of feedback - videotape and audiotape - which can be provided teachers immediately after they complete a microteaching lesson.

Typically, educators using the microteaching method have relied upon videotape feedback, although supervisor and student feedback have also been used (Acheson, 1964; McDonald & Allen, 1967). The teacher practices new skills by teaching a short lesson, which is recorded on a videotape

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1. Dr. Dell is affiliated with Westinghouse Learning Corporation.
2. See Borg, Kelley, Langer, & Gall (1970, Ch. 2).

recorder (VTR), to a few students. Then the teacher views the videotape replay in order to evaluate how effectively he has used the skills. Although videotape feedback has been shown to be an effective technique, it has several disadvantages of a practical nature. Videotape recorders are: (1) still relatively expensive (although the cost is lowering); (2) many school districts do not own them, and thus cannot use microteaching for inservice teacher-training; (3) maintenance of VTRs is relatively expensive; and (4) they are not easily transported. It occurred to us that audiotape recorders (ATR) might be used in microteaching as a substitute for VTRs to overcome these disadvantages. Audiotape recorders are inexpensive, commonly available, easily maintained, and easily transported. However, little is known concerning the effectiveness of ATRs as a feedback instrument in microteaching.

In one previous study of this problem, Ward (1970) found that VTR and ATR feedback were not significantly different in their effectiveness when used in microteaching to bring about improvement in teachers' use of higher-cognitive questions. This finding is not surprising in view of the fact that questioning is essentially a verbal skill and the ATR reproduces verbal interaction as accurately as does the VTR. In the study reported here, their relative effectiveness is compared when used to improve teachers' skills in mathematics tutoring.

Method

To study this problem, a group of teachers was recruited to take Minicourse 5, ("Individualizing Instruction in Mathematics," a teacher-training program developed by the Far West Laboratory for Educational Research and Development and distributed commercially by Macmillan Educational Services).

Minicourses are self-instructional packages of 4 to 6 lessons. Each lesson typically contains 4 steps based on the microteaching procedures developed at the Stanford School of Education (Allen & Ryan, 1969). The teacher: (1) views instructional and model films demonstrating several behaviorally-defined teaching skills; (2) practices the skills in a micro-teach lesson; (3) evaluates the replay of the videotape recording that he has made of the lesson; and (4) repeats steps 2 and 3 to obtain further practice. In Minicourse Five, teachers conduct 7 microteach lessons, each involving tutoring one student on number operations (e.g., addition, subtraction) and another student on verbal problems. The objectives for each lesson of Minicourse Five are presented in Table 1.

Substantial evidence has been collected demonstrating that the Minicourse instructional strategy, based on microteaching with videotape feedback, significantly improves teachers' classroom skills (Borg, et. al., 1970). In these studies, for example, Minicourse Five brought about substantial improvement in tutoring skills of preservice and inservice teachers. The specific question raised by the present study, then, is whether audiotape feedback lessens or enhances the effectiveness of the microteaching procedure used in Minicourses.

Teachers recruited for the study were all inservice elementary school teachers using Project PLAN, which is an individualized instruction curriculum developed jointly by the American Institutes for Research and Westinghouse Learning Corporation. Thirty-five of the teachers were randomly assigned either to the "audio" or to the "video" version of the course. The two versions were identical in all respects except that the audio group used audiotape rather than videotape for recording their microteach lessons.

Feedback consisted of the teachers replaying their audiotape or videotape recordings to self-evaluate their use of each tutoring skill covered in the course. Fifteen additional teachers who did not take the course served as a control group. Mean age, teaching experience, and grade levels taught by the three groups are shown in Table 2.

To determine the effectiveness of the treatments, all teachers were asked to conduct two videotaped ten-minute tutoring sessions both before and after completing the Minicourse, which lasted a period of four weeks and involved about 13 hours of instruction. In the first session, each tutored a student from his classroom who was having difficulty with number operations. In the second session, each teacher assisted another student in solving a verbal reasoning problem.

Each videotape was scored by two trained raters for occurrences of the tutoring techniques covered in the Minicourse. A few videotapes from each treatment group were not scorable because of poor audio-video quality, or because directions for conducting the tutoring sessions were not followed. Inter-rater reliability was generally high.[3]

Results

1. Diagnostic Questions. A frequency count was made of teachers' use of five types of diagnostic questions in the two tutoring sessions. Diagnostic questions are recommended to teachers because they help reveal gaps in students' understanding of mathematical concepts and number operations.

Analysis of covariance, with pre-course scores as the co-variate, was used to determine whether the treatments resulted in significant differences

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3. Reliability estimates for scoring videotapes for occurrence of various tutoring techniques can be found in Borg, et. al., 1970, p. 156).

between groups. As shown in Table 3, covariance analysis and post-hoc t-tests indicated that the "audio" and "video" teachers made significantly greater use of diagnostic questions than the control group. The results for the two treatments were quite similar: about 80 percent of the teachers improved their use of diagnostic questioning, and the average gain from pre-course to post-course was about 50 percent.

2. Demonstration Techniques. Raters recorded the amount of time spent by teachers in using six demonstration techniques: estimation, expanded notation, number line, manipulative materials, diagram or picture of a verbal problem, and number sentences. Use of these techniques is valuable in explaining to students various mathematical concepts and number operations. Raters also counted the number of techniques used in each tutoring session.

Because the time measures were skewed, the Wilcoxon signed-ranks test rather than analysis of covariance was used to evaluate pre-post course changes. The results are shown in Table 4. It appears that the "video" group made the most substantial improvement. However, the "audio" group also made gains although they did not reach statistical significance, perhaps because of the variability of scores and small sample size. The control group showed a slight decrease in the pre-post number operations sessions, and only a slight increase in the pre-post verbal problem sessions.

One of the goals of Minicourse Five is to increase the variety of demonstration techniques used by teachers to explain number concepts and operations. In Table 5 is shown the percentage of teachers using 0, 1, or 2 or more techniques before and after the course. Both the "video" and "audio" groups showed equivalent, substantial pre-post gains in this aspect of

tutoring. By contrast, the control group showed relatively little change from pre- to post-taping.

3. Evaluation. Raters recorded whether an evaluation example was assigned to the student. Evaluation is an important aspect of tutoring since it provides feedback to the teacher on his effectiveness and on the student's learning as a result of tutoring. If the student cannot solve an evaluation example successfully, the teacher is advised to engage in further diagnostic questioning and use of demonstration techniques.

The results of data analysis on this variable are shown in Table 6. Significant, though modest, gains occurred only for "audio" group. One reason for not obtaining larger gains may be that teachers incorporated evaluation procedures into the demonstration phase of tutoring, and thus did not perceive the need to assign a separate example for evaluation at the conclusion of tutoring.

4. Practice. Raters recorded the presence or absence of a practice phase of tutoring. They scored this phase as present if the teacher made a statement such as, "Now do these examples at your desk," or "Here are some to do for practice." Mathematics educators strongly advocate practice to consolidate and maintain student learning.

The findings from the data analysis on this variable are shown in Table 7. Both the "video" and "audio" groups made significant equivalent gains, whereas not a single control teacher assigned examples for practice either before or after the time interval of the Minicourse.

5. Verbal Praise. Teachers' use of verbal praise statements to reward students for correct responses was evaluated for a subsample of the three treatment groups. Because the data were skewed, the Wilcoxon signed-

ranks test was used to analyze pre-post differences. Table 8 shows that the "video" teachers made a moderate, though not significant gain. The "audio" teachers made a small gain, whereas the control group decreased somewhat from pre-test to post-test.

6. Length of Tutoring Sessions. Teachers were allowed up to ten minutes to conduct each pre-post tutoring session. If a teacher took longer than the allotted time, raters were instructed to score only the skills that occurred during the first ten minutes.

One might conjecture that the observed gains occurred because the "video" and "audio" groups spent more time tutoring than the control group. However, Table 9 demonstrates that this did not occur. The "video" and "audio" groups actually spent less time in the post-course sessions, whereas the control group showed a slight increase.

7. Questionnaire Data. After completing the Minicourse, teachers in the "audio" and "video" groups were asked to fill out a questionnaire concerning their reactions to the course. Their responses are summarized in Table 10. It is apparent that both groups had favorable reactions to the Minicourse, and their pattern of responses did not differ substantially from each other.

On item 2, approximately 50 percent of teachers in both groups stated that they had not increased the amount of time they spend tutoring as a result of the Minicourse. This finding can be explained by considering the fact that these teachers were using a curriculum based upon individualized instruction and had received prior training in using tutoring to implement this curriculum. In two other studies we have completed with teachers working in conventional classrooms, approximately 75 percent of them stated that the Minicourse helped them to increase their use of tutoring.

In order to determine teachers' liking for a particular feedback mode, "video" teachers were asked if they would prefer to have received audiotape feedback; and "audio" teachers were asked if they would prefer to have received videotape feedback. Of the 18 "video" teachers responding to this question, only one said that she would prefer audiotape feedback. The response of the "audio" teachers was less lopsided: 8 of 14 teachers would have preferred videotape feedback. It seems that if teachers are actually exposed to audiotape feedback, about half of them will develop preferential attitudes toward it. However, without this exposure, almost all teachers will prefer to have videotape feedback.

Conclusions

Educators who wish to use the microteaching method to train teachers may be concerned that: (1) audiotape feedback will not help teachers improve their classroom skills; or that (2) audiotape feedback will not be nearly as effective as videotape feedback. Our findings, and those of Ward, suggest that neither concern is justified. Teachers can make significant improvements in classroom skills by listening to audiotape feedback. And the overall pattern of findings suggests that audiotape feedback is neither significantly better nor significantly worse than videotape feedback. However, teachers do seem to prefer videotape feedback and it may well be that this technique also fosters certain kinds of incidental learning (for example, about physical mannerisms) not possible with audiotape feedback. These advantages, though, should be balanced against practical factors (expense, maintenance, transportability) that generally favor use of audiotape recorders.

Since the problem of videotape versus audiotape feedback has important practical implications, more replication studies are needed to determine

whether the present findings can be generalized to other teacher groups and to other types of classroom skills. One might hypothesize that videotape feedback would be superior for skills involving a substantial "visual" aspect, but there would be no difference between videotape and audiotape feedback for verbal skills. In the present study, there was no difference between the feedback modes for the major verbal skill - diagnostic questioning. However, the findings tend to favor videotape feedback for training teachers in demonstration techniques, most of which contain a visual element (for example, use of the number line, expanded notation, pictures to illustrate verbal problems). Perhaps more clear-cut differences did not emerge because the "audio" teachers, in listening to their audiotape playback, also had available the worksheets used during the tutoring session. These worksheets undoubtedly helped them reconstruct the visual aspects of the session, and contributed to the effectiveness of audiotape feedback.

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TABLE 1
Minicourse 5 Objectives and Skills

INSTRUCTIONAL SEQUENCE 1	
Objective	To improve teacher skill in rewarding pupils' correct responses and encouraging their active participation in the tutoring process.
Skills Covered	Using verbal praise to reward correct responses.
	Asking prompting questions to increase pupils' active involvement in the tutoring process.
INSTRUCTIONAL SEQUENCE 2	
Objective	To increase teacher skill in diagnosing pupils' deficiencies in understanding of mathematical concepts and computational procedures.
Skills Covered	Asking general diagnostic questions (e.g., "How did you get your answer?").
	Number operations: asking questions to test pupils' understanding of place value, regrouping, and other number concepts.
	Verbal problems: asking questions which test pupils' ability to read the problem and to decide on an appropriate number operation.
INSTRUCTIONAL SEQUENCE 3	
Objective	To increase teacher use of techniques which help to develop pupils' understanding of mathematical concepts and computational procedures.
Skills Covered	Estimating an answer prior to using a computational algorithm.
	Number operations: depending on the situation, using expanded notation, the number line, or manipulative materials.
	Verbal problems: having the pupil draw a picture of the problem and having him write a number sentence to express the problem's requirements.
INSTRUCTIONAL SEQUENCE 4	
Objective	To increase teacher skill in evaluating student progress and assigning practice examples.
Skills Covered	Assigning an evaluation example.
	Assigning practice examples.
INSTRUCTIONAL SEQUENCE 5	
Objective	To improve teacher skill in organizing the mathematics class period for individual tutoring.
Skills Covered	Having pupils correct their own work.
	Having pupils tutor each other (peer tutoring).

Table 2

CHARACTERISTICS OF PARTICIPATING TEACHERS

Treatment Group	No. of Teachers	Mean Age	Mean Years of Teaching Experience	Grade Level Taught				
				1st	2nd	3rd	5th	6th
(a) Videotape feedback	19	33.0 (S.D.=10.4)	8.0 (S.D.=6.2)	4	3	4	4	4
(b) Audiotape feedback	16	38.3 (S.D.=10.0)	11.1 (S.D.=7.4)	4	4	3	2	3
(c) Control	15	40.4 (S.D.=10.2)	11.6 (S.D.=6.1)	3	3	3	3	3

Table 3

FREQUENCY OF DIAGNOSTIC QUESTIONS BEFORE AND AFTER THE MINICOURSE

Treatment Group	Number of Teachers	Mean Scores		Percentage Improving	Statistical Analysis
		Before	After		
(a) Videotape feedback	19	9.6 (S.D.=6.8)	15.6 (S.D.=7.0)	79%	Analysis of covariance F=7.15* Post-hoc t-tests (a) versus (c), t=3.33* (a) versus (b), t=0.36 (b) versus (c), t=3.52*
(b) Audiotape feedback	14	9.3 (S.D.=5.0)	14.8 (S.D.=4.8)	86%	
(c) Control	14	9.0 (S.D.=5.0)	8.1 (S.D.=4.9)	36%	

p<.01

Table 4

TIME SPENT USING DEMONSTRATION TECHNIQUES

A. Number Operations Session

Treatment Group	No. of Teachers	Mean No. of Seconds Before	Mean No. of Seconds After	Percentage Improving	Test of Significance
(a) Videotape feedback	19	140 (S.D.=179)	293 (S.D.=170)	84%	z=2.67**
(b) Audiotape feedback	16	196 (S.D.=169)	275 (S.D.=161)	63%	z=1.14
(c) Control	15	195 (S.D.=232)	179 (S.D.=189)	40%	z=0.08

B. Verbal Problem Session

Treatment Group	No. of Teachers	Mean No. of Seconds Before	Mean No. of Seconds After	Percentage Improving	Test of Significance
(a) Videotape feedback	19	154 (S.D.=164)	253 (S.D.=121)	79%	z=2.20*
(b) Audiotape feedback	14	176 (S.D.=150)	264 (S.D.=161)	64%	z=1.28
(c) Control	14	182 (S.D.=181)	219 (S.D.=207)	50%	z=0.39

*$p < .02$
**$p < .005$

Table 5

NUMBER OF DEMONSTRATION TECHNIQUES
USED BEFORE AND AFTER THE MINICOURSE

A. Number Operations Session

Treatment Group	No. of Demonstration Techniques	Percentage of Teachers Before	After	χ^2
(a) Videotape feedback	0	42%	5%	1.68
	1	16%	32%	
	2+	42%	63%	
(b) Audiotape feedback	0	13%	13%	4.50*
	1	56%	19%	
	2+	31%	68%	
(c) Control	0	33%	27%	0.68
	1	33%	53%	
	2+	34%	20%	

B. Verbal Problem Session

Treatment Group	No. of Demonstration Techniques	Percentage of Teachers Before	After	χ^2
(a) Videotape feedback	0	32%	5%	18.61**
	1	42%	0%	
	2+	26%	95%	
(b) Audiotape feedback	0	14%	14%	5.25*
	1	50%	7%	
	2+	36%	79%	
(c) Control	0	21%	29%	0.57
	1	36%	14%	
	2+	43%	57%	

*$p < .05$
**$p < .001$

Table 6

ASSIGNMENT OF EVALUATION EXAMPLES
BEFORE AND AFTER THE MINICOURSE

Treatment Group	No. of Teachers	Frequency of Occurrence	Percentage of Teachers Before	Percentage of Teachers After	χ^2
(a) Videotape feedback	19	Did not occur	74%	68%	0.12
		Occurred in one session	21%	32%	
		Occurred in both sessions	5%	0%	
(b) Audiotape feedback	16	Did not occur	69%	25%	6.15*
		Occurred in one session	13%	50%	
		Occurred in both sessions	19%	25%	
(c) Control	15	Did not occur	40%	40%	0.00
		Occurred in one session	53%	40%	
		Occurred in both sessions	7%	20%	

*$p < .02$

Note: "Occurred in one session" and "Occurred in both sessions" were collapsed into one category for chi-square analysis.

Table 7

ASSIGNMENT OF PRACTICE EXAMPLES
BEFORE AND AFTER THE MINICOURSE

Treatment Group	No. of Teachers	Frequency of Occurrence	Percentage of Teachers Before	After	χ^2
(a) Videotape feedback	19	Did not occur	100%	63%	8.58*
		Occurred in one session	0%	32%	
		Occurred in both sessions	0%	5%	
(b) Audiotape feedback	16	Did not occur	94%	50%	7.57*
		Occurred in one session	6%	31%	
		Occurred in both sessions	0%	19%	
(c) Control	15	Did not occur	100%	100%	0.00
		Occurred in one session	0%	0%	
		Occurred in both sessions	0%	0%	

$p < .01$

Table 8

FREQUENCY OF VERBAL PRAISE STATEMENTS

Treatment Group	Number of Teachers	Mean Frequency		Wilcoxon Signed-Ranks Test
		Before	After	
(a) Videotape feedback	9	9.7 (S.D.=6.4)	17.0 (S.D.=7.5)	z = 0.55
(b) Audiotape feedback	8	15.0 (S.D.=10.7)	16.4 (S.D.=8.0)	z = 0.11
(c) Control	8	18.8 (S.D.=6.7	14.0 (S.D.=6.4)	z = -0.63

Table 9

LENGTH OF BOTH TUTORING SESSIONS

Treatment Group	No. of Teachers	Mean Length in Minutes Before	After
(a) Videotape feedback	19	18.8 (S.D.=1.4)	18.6 (S.D.=2.0)
(b) Audiotape feedback	14	19.2 (S.D.=1.5)	18.4 (S.D.=2.5)
(c) Control	14	18.8 (S.D.=2.5)	19.0 (S.D.=2.2)

Table 10

QUESTIONNAIRE RESPONSES

1. To what extent has your math tutoring improved as a result of the Minicourse?

Extent of Improvement	Videotape Feedback (N=18)	Audiotape Feedback (N=14)
Considerable improvement	11%	29%
Some improvement	89%	57%
Slight improvement	0%	14%
No improvement	0%	0%

2. Has the amount of classroom time you spend in tutoring students in math . . .

	Videotape Feedback (N=13)	Audiotape Feedback (N=12)
Increased considerably?	0%	0%
Increased somewhat?	31%	33%
Increased slightly?	23%	17%
Not increased?	46%	50%

3. How do you feel the Minicourse compares with other inservice training experiences you have had?

Comparison	Videotape Feedback (N=17)	Audiotape Feedback (N=13)
Much better than	35%	31%
Better than	59%	46%
On a par with	6%	23%
Worse than	0%	0%
Much worse than	0%	0%

4. As compared to your college (preservice) eeucation courses, how would you rate the Minicourse?

Comparison	Videotape Feedback (N=17)	Audiotape Feedback (N=14)
Much better than	53%	29%
Better than	35%	36%
On a par with	12%	21%
Worse than	0%	14%
Much worse than	0%	0%